SECTION C — (3 × 10 = 30 marks)

Answer any THREE questions.

16. (a) Write all possible Laurent series for the function $f(z)=\frac{1}{z(z+2)^3}$ about the pole $z=-2$.

(b) Expand $f(z)=\frac{1}{(z+1)(z+3)}$ as Laurent series is valid for

(i) $|z|<1$ and (ii) $1<|z|<3$

17. Obtain the solution of Laplace equation in cartesian coordinates.

18. Using Laplace transform solve the following differential equations.

(a) $y''+9y=0$; $y_0=0$ and $y_1=2$ and

(b) $\frac{d^2z}{dt^2}-2\frac{dx}{dt}+2x=0$; $x_0=x_1=1$.

19. Discuss Irreducible representation and character of $SU(2)$.

20. Define Binomial distribution. Show that the mean and variance of Binomial distribution are np and npq respectively.

NOVEMBER/DECEMBER 2025

GPH21/DPH21 — MATHEMATICAL PHYSICS - II

Time : Three hours Maximum : 75 marks

SECTION A — (10 × 2 = 20 marks)

Answer ALL questions.

1. Write Cauchy-Riemann equation in polar form.

2. Check whether $\sin z$ and $\log z$ are analytic.

3. Write Laplace equation in spherical polar coordinates.

4. Write down the solution of two dimensional heat flow diffusion equation.

5. State convolution theorem.

6. List out the few applications of Fourier transform.

7. What is a point group? Give examples.

8. State Great orthogonally theorem.

9. Write the moment generating function of Poisson distribution

10. State Laplace – de Moivre limit theorem.

SECTION B — (5 × 5 = 25 marks)

Answer ALL questions.

11. (a) Find the residue at each pole of the function

$$f(z)=\frac{z^2}{(z-1)^2(z+2)}.$$

Or

(b) State and prove Taylor series.

12. (a) Obtain D'Alembert's solution to the wave equation for the vibrating string and give its physical interpretation.

Or

(b) Explain two dimensional cylindrical coordinates with a suitable examples.

13. (a) Find the Fourier sine transform of $f(x)=\frac{e^{-ax}}{x}$.

Or

(b) Find the Laplace transform of $\frac{1}{t}f(t)$.

14. (a) Show that the group of order 2 and 3 are always cyclic.

Or

(b) Explain the properties of conjugate elements.

15. (a) Explain moment generating function of normal distribution.

Or

(b) Determine the probability of throwing more than 8 with 3 perfectly symmetrical dice.